

```

/* wxMaxima 0.7.1 http://wxmaxima.sourceforge.net
Maxima 5.11.0 http://maxima.sourceforge.net
Using Lisp GNU Common Lisp (GCL) GCL 2.6.8 (aka GCL)
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Dedicated to the memory of William Schelter.
This is a development version of Maxima. The function bug_report()
provides bug reporting information.

```

```
(%i2) psi:makelist(t^n, n, 0, 3);
```

```
(%o2)  [ 1 , t , t^2 , t^3 ]
```

```
(%i3) psi(n,t):=ev(psi[n+1]);
```

```
(%o3)  psi(n , t) := ev(psi_{n+1})
```

```
(%i4) psi(2,t);
```

```
(%o4)  t^2
```

```
(%i5) inner(x,y):=(1/2)*integrate(x*conjugate(y), t, -1, 1);
```

```
(%o5)  inner(x , y) := \frac{1}{2} \integrate(x conjugate(y) , t , -1 , 1)
```

```
(%i6) norm(x):=sqrt(inner(x,x));
```

```
(%o6)  norm(x) := \sqrt{inner(x , x)}
```

```
(%i7) phi:[];
```

```
(%o7)  [ ]
```

```
(%i8) phi:append(phi,[psi(0,t)/norm(psi(0,t))]);
```

```
(%o8)  [ 1 ]
```

```
(%i9) u:[];
```

```
(%o9)  [ ]
```

```
(%i10) u:append(u,[phi[1]]);
```

```
(%o10) [ 1 ]
```

```
(%i11) for n:2 thru 4 do
(u:append(u,[psi[n]-sum(inner(psi[n],phi[m])*phi[m],m,1,n-1)]),
phi:append(phi,[u[n]/norm(u[n])]))$
```

```
(%i12) u;
```

```
(%o12) [ 1 , t , t^2 - 1/3 , t^3 - 3t/5 ]
```

```
(%i13) phi;
```

```
(%o13) [ 1 , sqrt(3)t , (3*sqrt(5)*(t^2 - 1/3))/2 , (5*sqrt(7)*(t^3 - 3t/5))/2 ]
```

```
(%i14) P2_c[i,j]:=inner(phi[i],phi[j]);
```

```
(%o14) P2_c_i , j := inner(phi_i , phi_j)
```

```
(%i15) genmatrix(P2_c,4,4);
```

```
(%o15) [ 1 0 0 0
         0 1 0 0
         0 0 1 0
         0 0 0 1 ]
```

```
(%i16) x(t):=sin(%pi*t);
```

```
(%o16) x(t) := sin(%pi t)
```

```
(%i17) c:[];
```

```
(%o17) [ ]
```

```
(%i18) for n:1 thru 4 do
(c:append(c,[inner(x(t),phi[n])]))$
```

```
(%i19) c;
```

$$(\%o19) \quad \left[0, \frac{\sqrt{3}}{\pi}, 0, \frac{\sqrt{7}(2\pi^2 - 30)}{2\pi^3} \right]$$

(%i20) phi(n,t):=ev(phi[n]);

$$(\%o20) \quad \text{phi}(n, t) := \text{ev}(\text{phi}_n)$$

(%i21) phi(1,t);

$$(\%o21) \quad 1$$

(%i22) xhat(t):=sum(c[n]*phi(n,t),n,1,4);

$$(\%o22) \quad \text{xhat}(t) := \text{sum}(c_n \text{phi}(n, t), n, 1, 4)$$

(%i23) xhat(t);

$$(\%o23) \quad \frac{35(2\pi^2 - 30)\left(t^3 - \frac{3t}{5}\right)}{4\pi^3} + \frac{3t}{\pi}$$

(%i24) ratsimp(%);

$$(\%o24) \quad \frac{(35\pi^2 - 525)t^3 + (315 - 15\pi^2)t}{2\pi^3}$$

(%i25) MSE:(norm(x(t)-xhat(t)))^2;

$$(\%o25) \quad \frac{\pi^6 - 20\pi^4 + 420\pi^2 - 3150}{2\pi^6}$$

(%i26) if numer#false then numer:false else numer:true;

$$(\%o26) \quad \text{true}$$

(%i27) MSE;

```
(%o27) 
$$\frac{\pi^6 - 20\pi^4 + 420\pi^2 - 3150}{2\pi^6}$$

```

```
(%i28) ratsimp(%);
```

```
(%o28) 0.0043901166619365
```

```
(%i29) if numer#false then numer:false else numer:true;
```

```
(%o29) false
```

```
(%i30) xtay(t):=sum((block (diff(x(q),q,n), ev (%%, q=0)))*(t^n)/n!,n,1,4);
```

```
(%o30) xtay(t) :=
```

$$\text{sum}\left(\frac{\text{block}(\text{diff}(x(q), q, n), \text{ev}(\%, q = 0)) t^n}{n!}, n, 1, 4\right)$$

```
(%i31) xtay(t);
```

```
(%o31)  $\pi t - \frac{\pi^3 t^3}{6}$ 
```

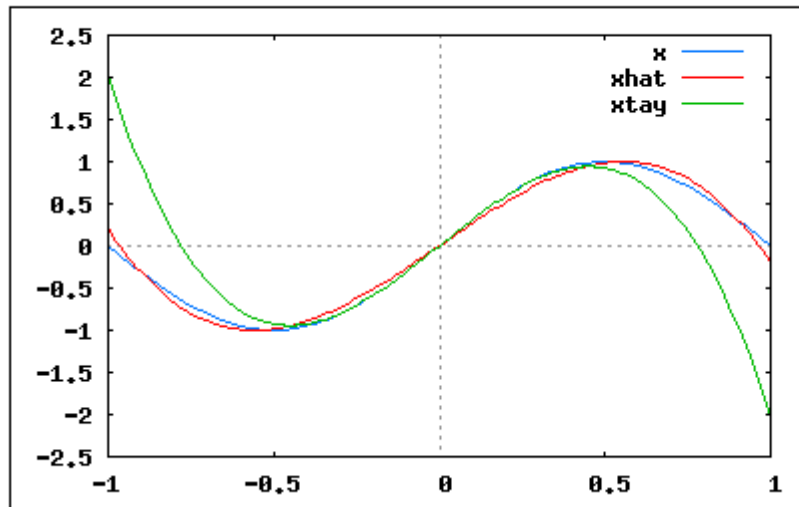
```
(%i32) print("built-in Taylor function gives",taylor(x(t),t,0,3));
```

```
built-in Taylor function gives  $\pi t - \frac{\pi^3 t^3}{6} + \dots$ 
```

```
(%o32)  $\pi t - \frac{\pi^3 t^3}{6} + \dots$ 
```

```
(%i35) wxplot2d([x,xhat,xtay],[t,-1,1]);
```

(%o35)



(%i36) e(t):=x(t)-xhat(t);

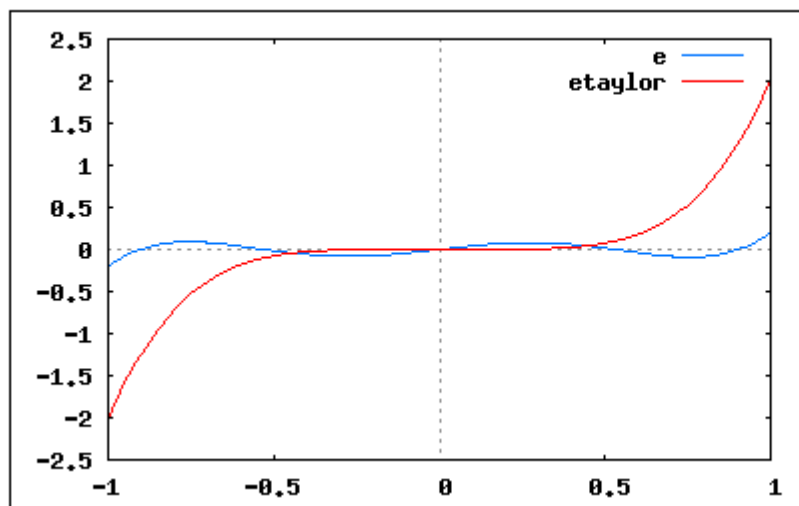
(%o36) $e(t) := x(t) - xhat(t)$

(%i37) etaylor(t):=x(t)-xtay(t);

(%o37) $etaylor(t) := x(t) - xtay(t)$

(%i38) wxplot2d([e,etaylor], [t,-1,1]);

(%o38)



(%i39)